**Taiwan spent nuclear fuel:
Is the solution in France?**

By mid-July 2022 the French-language newsletter QuestionChine *posted on-line an article to answer this question. It is summarized just below in English (and separately in Chinese) to be freely disseminated.*

Reminder: For the French, NSF is not waste: Nuclear spent fuel can be recycled. Its reprocessing is a globally recognized French expertise. Such recycling has been routine in France for half a century — for its own power utilities and also for its foreign customers in Japan, Germany, Switzerland, etc.

After recycling, the next step is manufacturing of a new fuel, mixing ex-reprocessing plutonium and ex-reprocessing uranium: MOX (Mixed Oxides Fuel).

In France, this MOX fuel is routinely used in 22 power reactors (out of 58) and provides more than 10% of the nation's electricity.

In Taiwan, the over-accumulation in the over-saturated pools of the ChinShan and KuoSheng reactors is delaying their dismantling. In the context of the recognized electricity shortage in Taiwan, evidenced in frequent black-outs, it might be appropriate to extend the operation of the KuoSheng n°2 reactor. But this presupposes that (at least) 180 tonnes of spent fuel would removed.

In Taiwan, the need to resolve once and for all the question of these spent fuels is widely acknowledged, and lends itself to swift achievement of a domestic consensus. However, doing so requires resumption of a real dialogue between the relevant Taiwan bodies and two French entities:

* *Between Taiwan Power Company (its Nuclear Back-End Department) the owner of NSF, and the French industrial specialist in reprocessing, Orano (the new name of Cogema)*

* *Between the AEC's FCMA and the French Nuclear Safety Authority (ASN). The ASN is the French equivalent of the American NRC, in charge of nuclear safety.*

Nota bene: For a separate, different issue, that of the Orchid Island LLRW (Low-Level Radioactive Waste), France could also contribute to a solution. This would be within the framework of separate cooperation with France's ANDRA. This will be the subject of another article.

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TPC in 1983 signed one of the main industrial contracts between France and Taiwan with Cogema (now known as Orano), covering one third of the enriched uranium needs of its six reactors.

This contract was exemplary, concluded without any commission whatsoever for go-betweens, and certainly without any kick-backs, Its execution unfolded smoothly, without the slightest dispute. Signed for an initial 20 years, it remained in force until 2013: About thirty, utterly harmonious, years.

With six reactors in operation, nuclear power accounted for about one third of Taiwan's electricity over a number of years. (Today with the only two MaAnShan reactors, it is only 9%.). This nuclear electricity has been green (carbon-free), plentiful, cheap, pollution-free, and "geo-politically secure" — since an inventory "a few years ahead" of fuel (for a third of the total production of Taiwanese electricity !) could be stored safely in surprisingly modest space, a few m3: a ratio unequaled by any other energy source.

Let's repeat it: several years inventory in reserve, without any worry about a break in supply. By contrast, liquefied gas can only be stored for a few days, and it depends on maritime transportation subject to myriad unpredictable hazards. Coal can be stored for a few months, but at the cost of intense initial pollution arising from storage alone, that is, even before the process of burning projects into the atmosphere incredible quantities of very harmful waste.

The decisive element of the negotiation, conducted by René Viénet with TPC and the Taiwan government, was that TPC as required could send its spent fuel to LaHague in France for recycling.

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This prospect of recycling in France was encouraged by Washington, anxious that the plutonium contained in this spent fuel not linger idle on the island:

As of July 2022, about thirty tons of Pu are contained within 3,000 tons of spent fuel stored at ChinShan and KuoSheng -- in the greater Taipei area.

The photos illustrating this article also serve as a reminder of the essential role then played by eminent French parliamentarians, including the President and the Quaestor of the Senate, encouraged by the French President, in explaining to Minister Li KuoTing that France would be a reliable long-term partner — upstream with the supply of enriched uranium, downstream with the recycling of spent fuel.

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Also to be noted: We were in another era and time, when Beijing also was predisposed to favor an approach whereby Taiwan entrusted France with its spent nuclear fuel:

At an April 1993 Beiing Technicatome symposium on the back-end of the nuclear fuel cycle, organized by René Viénet, Beijing concerned officials offered final disposal (for a modest and reasonable fee of US$ 1,000/drum) LLRW (low-level radioactive waste, i.e. "short-lived low-level waste"), from Taiwan nuclear power stations: to start with, some 100,000 drums, inadequately housed on LanYu island. This required that France's SGN corporation would assume responsibility for fiber-concrete packaging and transportation. French bureaucrats derailed the concept, for reasons sadly unrelated to the logic and merits of the proposal ...

INIS (International Nuclear Information System of the IAEA, the Atomic Energy Agency, in Vienna) on-line on the Web, offers access to the proceedings (with some photos) of this symposium, which then represented an exceptional opening of China to Taiwan:

Viénet, in the wake of this initiative, launched another: a lunch invitation to senior Chinese and Taiwan counterparts responsible for nuclear energy matters to confirm the proposal aired at the seminar. He brought together Taiwan's vice-minister for atomic energy, Dr Liu KuangChi, with a PRC equivalent, at the famous duck restaurant 全聚德 next to QianMen, to confirm the earlier proposal by Dr. Pan ZiQuiang, a very friendly scholar whose collection of stamps had been destroyed by the Red Guards during the anti-cultural counter-revolution. A member of the Chinese Academy of Engineering Sciences and a specialist in radiological protection, Pr Pan died in January 2022).

With Viénet, the two vice-ministers laid out this concept:

-- After Taiwan's spent nuclear fuel was reprocessed in LaHague, the subsequent corresponding MOX could be used in DaYa Bay and/or LingAo (the four reactors, supplied by Framatome to GuangDong province, the first two paid for by the Hong Kong utility).

-- Then the final waste from reprocessing at LaHague, the (vitrified) fission-products, 4% of the total NSF mass, could — in exchange — be received and disposed of permanently at BeiShan, in North-West China, thus avoiding their return to Taiwan.

-- In a few words: None of the spent fuel dispatched to France would be returned to Taiwan.

TPC was suggested - then - to finance the construction, at HuiAn (in FuJian province, across Taiwan Strait), of a power plant comparable to that of DaYa Wan (also to be supplied by France) one of whose two reactors would have supplied power to Taiwan thru a DC submarine cable. This was the same principle that had allowed the financing by Hong Kong,

and the construction by France, of the first Chinese nuclear power plant at DaYa Bay (one of the reactors supplying Hong Kong, the other one GuangDong Province). At this time, FuJian had no nuclear reactors (it now has six) and this province was less wealthy.

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This is how it happened that, a few years later, Chairman of TaiPower Dr. Chang ChungChien came to Paris to offer Cogema (again, the previous name of Orano) a US$ one billion down payment for the removal of 3,000 tons of spent fuel at the earliest convenience of the French corporation.

But this interesting proposal was sabotaged by a coterie of French officials and executives with an agenda: hostile to Viénet imaginative solutions, hostile to the development of industrial relations with Taiwan. It would take a dozen years for these individuals and their baleful influence to be eliminated from positions of authority.

It was necessary to wait until 2015 to relaunch a (far more modest) "pilot project of 180 tons" (compared to 3,000 tons previously),

But this project was in turn scuttled, this time at the Taiwan end. DPP Legislators (then in opposition) focused on a certain opacity of the KMT government (in power at the time) in the packaging of the project.

Nota bene: anything related to nuclear electricity benefits from early and honest explanation to the public, the media, and elected officials - by showing that there is no risk of chicanery, agent fees or kickbacks: Nuclear power must be, and can only be, an honest and model industry.

The lessons of these two previous failures have now been fully examined and assimilated. Viénet's efforts between 1980 and 1998 can be appreciated for their clarity and efficiency. All can now acknowledge that neither Washington nor Beijing wishes to see Taiwan retain 30 tons of idle plutonium. So we can hope that in 2022 the dialogue between the two corporations, TPC and Orano, will finally succeed - after a quarter of a century.

Anti-nuclear and pro-nuclear citizens in Taiwan must find a consensus on this issue: basically, Taipei has every advantage in disposing of its spent nuclear fuel. Recycling in France is for Taiwan Power Company the optimal option from an economic point of view. It would be exhaustive and require no additional complexities nor later arrangements.

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Summer 2022:
Where is the problem?
Where is its possible solution?

<https://archive.org/details/20220104_20220104_2139/page/n14/mode/1up>

This opinion piece was on-line by January 2022. Offered in three languages, the article served as both a kind of snapshot and a catalyst. Since then, this article has aroused discussion and positive ferment in thinking, both in Taipei and Paris, but as yet there has been no final resolution.

The Orano CEO did confirm — in March 2022 — that he was open to sign a contract with TPC for the removal and recycling of spent fuel from Taiwan.

This would have two important consequences:

(a) Allow the scheduled but delayed dismantling of the two reactors at the ChinShan site. This dismantling is impossible as long as the two reactors and their pools are saturated with spent fuel,

(b) If necessary, extend (a blessing, because Taiwan now lacks sufficient and reliable electricity) by a few years the production of electricity out of the KuoSheng n° 2 reactor, (a reactor presently shut down because it is over-saturated with its spent fuel).

At the same time, the MoEA (Ministry of Economic Affairs) has considered how to give TaiPower a green light to start a new direct dialogue with Orano on the reprocessing of its spent fuel in France.

This internal process is presently "restrained" (withheld from public disclosure and discussion) — perhaps in part to ward off bad luck.

However, making it public would be useful and welcome: the best way to prove that there is movement is by moving.

MoEA oversees Taiwan Power Company, a state-owned enterprise. Its minister must seize the opportunity to speak loudly and publicly that the relevant French corporation has reestablished itself in a credible manner in Taiwan — since it shut down its representative office in Taipei a few years ago …

Also, MoEA needs an important corresponding partner at the French end to be designated and on the same page. This very important contract, spread over several years, will require an

experienced advisory banker or all kinds of sureties and counter-guarantees, involving the French government and its Ministry of Economic Affairs

In 1981-83 it was Banque Paribas, later joined by BNP bank, which played this decisive role of financial-engineer and guarantor. These two banks having now merged, we may expect that BNP-Paribas, well established in Taiwan, will be the leading candidate to assume responsibility for fundamental upstream duty.

It is relevant to recall that the budget corresponding to this very important contract is (largely) available in the Nuclear Back-End Fund that TaiPower has, in advance, contributed by paying an appropriate contribution into an escrow account, under the watchful supervision of the MoEA, for each kWh of nuclear origin.

This Nuclear Back-End Fund, is endowed to date with well over twelve billion US$, which can be used without delay.

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If reason and logic prevail,

We will quickly see the ASN (the French Nuclear Safety Agency) renew with the Atomic Energy Council of Taiwan (AEC) the cooperation agreement that its president, Professor Lacoste, had signed several years ago:

It is not insignificant, in fact, that the procedures for extracting spent fuel from the reactor pools, the supply of transport casks, and their shipment to France are validated from the point of view of safety. This is ASN's core expertise and duty.

Nota bene: ANDRA (French Agency for the Final storage/disposal of Radioactive waste) is not concerned by these Taiwanese spent nuclear fuels, but can also offer welcome proof that France is not disinterested in another nagging and well-known – but more easily resolved -- Taiwanese concern: that of the some 100,000 barrels of low-level radioactive waste (LLRW) now stored on Orchid Island.

Taipei since 2017 has sought to establish a comparable Taiwan Radwaste (management administration) Agency. ANDRA immediately sent three specialists to Taiwan (including the head of this mission in Taipei, Professor Patrick Landais, who has since become France High Commissioner for Atomic Energy) for a bilingual Chinese and English languages symposium which proved a real success. But the Taiwanese government project subsequently floundered, for having clumsily and at the wrong time attempted to include spent fuels — which are not radwaste …

The obstacles at the French end to signing and implementation of such a (very important) recycling contract are of a logistical nature, and are not political: LaHague, to meet the needs of the market, must increase its capacities in its storage pools.

But what is conjunctural is always easy to solve:

In the case of Taiwan, what is important to put into the equation is that the spent nuclear fuels in the metropolitan area of Taipei, in the middle of 7 million inhabitants, must finally move away — thereby relieving elected officials, local people, and DPP anti-nuclear voters.

These spent fuels should first go to, if necessary, the practically uninhabited site of MaAnShan (already belonging to TPC, which operates two reactors there). Such requires giving appropriate assurances, on the basis of a contract signed with Orano, to the elected officials of PingTung County that (1) this interim period will be truly short-lived, possibly spread over just a few years, and that (2) Orano will already have been involved in overseeing the evacuation from KuoSheng and ChinShan into dual-use, storage and transport, casks (unlike the immobile sarcophagi at ChinShan and KuoSheng rejected by all).

For such a short interim stop-over, there is a model in Switzerland, near Zurich, the Zwilag Centre, that should be visited by all Taiwan guests interested to discover LaHague …

This will serve to establish clearly the advantages of Orano's insertion into the downstream of the Taiwanese nuclear fuel cycle, half a century after having, upstream, been a friendly, reliable and valued partner.

We therefore perhaps find ourselves today once again in the favorable situation akin to that of 1995-97 that Viénet had worked from 1983 to bring to maturity. At that juncture the Chairman of TaiPower came to Paris to offer Cogema a substantial down payment for the removal of 3,000 tons of spent fuel, at the earliest convenience of the concerned French industrial corporation.

2022 年 08月 01日
魏延年



February 1983
Signature of enriched uranium supply contract which will last for 30 years



At French Senate, septembre 1981,
Minister Li KuoTing,
between Senate President Alain Poher
and Questaor Gérard Minvielle



At French Senate, September 1981,
with Taiwan delegation,
Cogema Chairman Georges Besse



Septembre 1981, at LaHague NSF reprocessing plant,
Dr Li KuoTing,
First on right, René Viénet.



Dr Li KuoTing, with Viénet on his right,
At LaHague, September 1981